REMARKS

Reconsideration of this application, as amended, is respectfully requested. Claims 1, 3-5, 7-19, 21-23, 25-29, 31-33, 35-47, 49-51 and 53-56 are pending. Claims 1, 3-5, 7-19, 21-23, 25-29, 31-33, 35-47, 49-51 and 53-56 stand rejected.

Claims 1, 7, 8, 9, 17, and 25 have been amended. Claims 3,4, 11, 22, 31-32, 39, 49, and 50 have been cancelled. No claims have been added. Support for the amendments is found in the specification, the drawings, and in the claims as originally filed. Applicants submit that the amendments do not add new matter.

Rejections Under 35 U.S.C. § 102

Claims 1, 5, 7, 8, 19, 23, 25, 29, 31-33, 35, 36, 47, 49-51 and 53-56 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,290,804, of Henley, et al. ("Henley").

Applicants have amended claim 1 to include forming a cleave layer in a substrate, wherein a material of the cleave layer comprises silicon-germanium (SiGe), and the substrate comprises silicon. The laser-induced cleaving along the cleave layer is performed by at least one of stoichiometrically adjusting a Ge content in a SiGe material of the cleave layer to match a bond breaking energy involving the SiGe material to a laser energy characterized by a laser wavelength, and selecting the laser wavelength to provide the laser energy to substantially match a bond-breaking threshold energy of the SiGe material, based upon at least a stoichiometric composition of the SiGe material of the cleave layer, wherein the laser wavelength is tuned to provide the laser energy to be greater than a band gap of SiGe and smaller than that of Si.

Henley discloses implanting energetic particles in a substrate to form a cleave layer, and directing a laser energy at an edge of the substrate to initiate a cleaving of the substrate (Figure 7, col. 6, line 57- col. 7, line 19).

In particular, Henley discloses

> Using hydrogen as the implanted species into the silicon wafer as an example, the implantation process is performed using a specific set of conditions....Of course, the type of ion used and process conditions depend upon the application.

(Henley, col. 4, lines 35-50) (emphasis added)

Thus, Henley merely discloses implanting energetic particles, such as hydrogen, in a silicon wafer, in contrast to forming a cleave layer on a substrate, wherein a material of the cleave layer comprises silicon-germanium (SiGe), and the substrate comprises silicon, as recited in amended claim 1. Further, Henley merely discloses that a type of ions implanted into the substrate to form a cleave layer depends on the application, in contrast to stoichiometrically adjusting a Ge content in SiGe material of the cleave layer to match a bond breaking energy of SiGe material to a laser energy characterized by a laser wavelength to perform laser-induced cleaving. Additionally, Henley fails to disclose tuning the laser wavelength to provide the laser energy be greater than a band gap of the SiGe material of cleave layer and smaller than that of Si to perform laser-induced cleaving, as recited in amended claim 1.

Because Henley does not set forth all the limitations of amended claim 1, Applicants respectfully submit that amended claim 1 is not anticipated by Henley under 35 U.S.C. § 102(e).

Because independent claims 29, 33, 35, 36, 47, 51, 53, 54, 55, and 56 contain at least the discussed above limitations of amended claim1, Applicants respectfully submit that claims 29, 33, 35, 36, 47, 51, 53, 54, 55, and 56 are likewise not anticipated by Henley under 35 U.S.C. § 102(e).

Given that claims 5, 7, 8, 19, 23, 25-28 depend, directly or indirectly, from amended claim 1, and add additional limitations, Applicants respectfully submit that claims 5, 7, 8, 19, 23, 25-28 are likewise not anticipated by Henley under 35 U.S.C. § 102(e).

Rejections Under 35 U.S.C. § 103

Claims 3, 4, 21 and 22 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Henley in view of U.S. Publication No.: 2003/0162367 of Roche ("Roche")

Claims 9-12, 15-18, 37-40 and 43-45 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Henley, in view of U.S. Patent No.: 6,740,604 of Kelly, et al. ("Kelly").

Claims 13, 14, 41 and 42 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Henley and Kelly, as applied to claim 12 above, and further in view of Roche.

Claims 26 and 27 are rejected under 25 U.S.C. 103(a) as being unpatentable over Henley in view of U.S. Publication No.: 2003/0153162 of Nakano, et al. ("Nakano").

With respect to amended claim 1,

Roche discloses forming a weakened zone in a substrate and directing a laser pulse into the substrate to cause cleavage in the weakened zone. More specifically, Roche discloses

> In this method, the weakened zone can be a porous zone, in particular, one formed by deposition or by implantation. When implantation is used, the implantation is of phosphorus, arsenic, protons, or rare gas ions. Also, the substrate or ingot forming element advantageously comprises semiconductor material(s), LiNbO.sub.3, LiTaO.sub.3, or a composite material thereof. Especially preferred are Silicon, SiC, GaAs, InP, GaN, SiGe, Ge, LiNbO.sub.3, LiTaO.sub.3, or a composite material thereof. (Roche, [0026]) (emphasis added)

In particular, Roche discloses

> In another preferred implementation of the invention, given by way of non-limiting indication, energy is deposited by means of a 1.06 .mu.m laser beam as described above directly into the implanted layer 7 where it is desired to cause splitting or fracture. The description relates to the case where the semiconductor 2 is constituted by silicon. Given that silicon is rather transparent at the YAG wavelength, it is possible to reach the layer 7 in the center of the stack 2, 4 by illuminating either face 13 or the opposite face of the structure. Advantage is taken of the implanted layer being naturally much more highly absorbent than the initial crystal, even when implantation is performed using protons. It is also possible to increase its absorption strongly by implanting ions of phosphorus or of arsenic or of any other suitable element.

(Roche, [0065]) (emphasis added)

Thus, Roche merely discloses the weakened zone that can be a porous zone, formed by deposition or by implantation in a substrate, and that the substrate comprises silicon, or SiGe, in contrast to forming a cleave layer in a substrate, wherein the cleave layer comprises silicon-germanium (SiGe), and the substrate comprises silicon, as recited in amended claim 1. Further, Roche merely discloses increasing the absorption of the implanting layer by implanting ions of phosphorus or of arsenic, in contrast to stoichiometrically adjusting a Ge content in SiGe material of the cleave layer to match a bond breaking energy of SiGe material to a laser energy characterized by a laser wavelength to perform laser-induced cleaving. Additionally, Henley fails to disclose tuning the laser wavelength to provide the laser energy be greater than a band gap of the SiGe material of the cleave layer and smaller than that of Si to perform laser-induced cleaving, as recited in amended claim 1.

As set forth above, Henly, similarly to Roche, fails to disclose such limitations of amended claim 1.

Thus, neither Henley, nor Roche, discloses, teaches, or suggests limitations of amended claim 1 of forming a cleave layer in a substrate, wherein a material of the cleave layer comprises silicon-germanium (SiGe), and the substrate comprises silicon, and performing laser-induced cleaving along the cleave layer by at least one of stoichiometrically adjusting a Ge content in a SiGe material of the cleave layer to match a bond breaking energy involving the SiGe material to a laser energy characterized by a laser wavelength, and selecting the laser wavelength to provide the laser energy to be greater than a band gap of SiGe and smaller than that of Si.

Therefore, Applicants respectfully submit that amended claim 1 is not obvious under 35 U.S.C. § 103 (a) over Henley in view of Roche.

Because independent claims 29, 33, 35, 36, 47, 51, 53, 54, 55, and 56 contain at least the discussed above limitations of amended claim1, Applicants respectfully submit that claims 29,

33, 35, 36, 47, 51, 53, 54, 55, and 56 are likewise not obvious under 35 U.S.C. § 103 (a) over Henley in view of Roche.

Given that claims 5, 7, 8, 19, 23, 25-28 depend, directly or indirectly, from amended claim 1, and add additional limitations, Applicants respectfully submit that claims 5, 7, 8, 19, 23, 25-28 are likewise not obvious under 35 U.S.C. § 103 (a) over Henley in view of Roche.

Applicants have amended claim 9 to include simultaneously applying a plurality of interfering laser beams to a substrate to induce cleaving of the substrate substantially along a laser-defined cleave plane; and designing a profile of a laser energy interference pattern along a thickness of the substrate to determine a depth of a desired cleave plane relative to a surface of the substrate.

The Examiner states that Henley fails to disclose " interferring laser beams with specifically tuned energies that form a interference profile" (Office Action, p. 5, 07/27/05). As such, Henley fails to disclose the limitations of amended claim 1 of designing a profile of a laser energy interference pattern along a thickness of the substrate to determine a depth of a desired cleave plane relative to a surface of the substrate.

Kelly discloses separating two layers of material from one another by decomposing an interface between the two layers. More specifically, Kelly discloses

> The process described here may also be used for lateral structuring. This can be carried out using various procedures. A focused light beam can be employed for sequentially exposing spatially separate points of the material and for bringing about the decomposition. As shown in the illustrative embodiment in FIG. 5, it is possible to use an exposure mask 10 through which selected areas of the sample can be removed. Likewise, in accordance with the illustrative embodiment in FIG. 6, exposure using holographic process is possible (for example exposure with an interference grating), in which the interference effects are utilized through simultaneous exposure to more than one coherent beam.

(Kelly, col. 7, lines 32-45) (emphasis added)

Further , Kelly discloses

> When structuring GaN layers by exposing the interface through a sapphire substrate, GaN structures with nonvertical, that is to say oblique side faces can be produced, which, as FIG. 9 shows, propagate from the decomposition site. This process can, for example, be used to produce structures 20 with a pointed or pyramidal design if the lateral width of the interference grating or the mask is matched to the layer thickness. This process also helps the production of cantilevered layers.

(Kelly, col. 9, lines 25-34) (emphasis added)

Thus, Kelly merely discloses providing an interference pattern (grating) laterally along a surface of the layer to act as a mask and matching the lateral width of the interference grating along the surface of the layer to the thickness of the layer, in contrast to designing a profile of a laser energy interference pattern along a thickness of the substrate to determine a depth of a desired cleave plane relative to a surface of the substrate, as recited in amended claim 9.

Thus, Kelly, similarly to Henley fails to disclose the limitations of amended claim 9 of designing a profile of a laser energy interference pattern along a thickness of the substrate to determine a depth of a desired cleave plane relative to a surface of the substrate.

Therefore, Applicants respectfully submit that amended claim 1 is not obvious under 35 U.S.C. § 103 (a) over Henley in view of Kelly.

Because independent claims 37, 38, and 40- 46 contain at least the discussed above limitations of amended claim 9, Applicants respectfully submit that claims 37, 38, and 40- 46 are likewise not obvious under 35 U.S.C. § 103 (a) over Henley in view of Kelly.

Given that claims 10, and 12-18 depend, directly or indirectly, from amended claim 9, and add additional limitations, Applicants respectfully submit that claims 10, and 12-18 are likewise not obvious under 35 U.S.C. § 103 (a) over Henley in view of Kelly.

Claims 13, 14, 41 and 42 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Henley and Kelly, and further in view of Roche.

Roche, as set forth above, fails to disclose simultaneously applying a plurality of interfering laser beams to a substrate to induce cleaving of the substrate substantially along a laser-defined cleave plane, as recited in amended claim 9. As such, Roche, similarly to Henley and Kelly, fails to disclose designing a profile of a laser energy interference pattern along a thickness of the substrate to determine a depth of a desired cleave plane relative to a surface of the substrate, as recited in amended claim 9.

Given that claims 41 and 42 include at least the discussed above limitations of amended claim 9, Applicants respectfully submit that claims 41, and 42 are likewise not obvious under 35 U.S.C. § 103 (a) over Henley in view of Kelly, and further in view of Roche.

Given that claims 13 and 14 depend, directly or indirectly, from amended claim 9, and add additional limitations, Applicants respectfully submit that claims 13 and 14 are likewise not obvious under 35 U.S.C. § 103 (a) over Henley in view of Kelly, and further in view of Roche.

Claims 26 and 27 are rejected under 25 U.S.C. 103(a) as being unpatentable over Henley in view of Nakano.

Nakano discloses implanting hydrogen ions or rare gas ions to form a micro bubble layer in the wafer, and delaminating the wafer at the micro bubble layer, and similarly to Henley, fails to disclose forming a cleave layer in a substrate, wherein a material of the cleave layer comprises silicon-germanium (SiGe), and the substrate comprises silicon. Additionally, Nakano, similarly to Henley fails to disclose performing laser-induced cleaving along the cleave layer by at least one of stoichiometrically adjusting a Ge content in a SiGe material of the cleave layer to match a bond breaking energy involving the SiGe material to a laser energy characterized by a laser wavelength, and selecting the laser wavelength to provide the laser energy to be greater than a band gap of SiGe and smaller than that of Si.

Therefore, Applicants respectfully submit that amended claim 1 is not obvious under 35 U.S.C. § 103 (a) over Henley in view of Nakano.

Given that claims 26 and 27 depend, directly or indirectly, from amended claim 1, and add additional limitations, Applicants respectfully submit that claims 26 and 27 are likewise not obvious under 35 U.S.C. § 103 (a) over Henley in view of Nakano.

It is respectfully submitted that in view of the amendments and arguments set forth herein, the applicable rejections and objections have been overcome. If there are any additional charges, please charge Deposit Account No. 02-2666 for any fee deficiency that may be due.

Respectfully submitted,

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